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ABSTRACT

A study was conducted at Montgomery College (MC) to investigate possible relationships between student enrollment and economic conditions and educational costs. The study methodology consisted of a correlation analysis and a time series multiple regression model. The study developed mathematical equations for predicting fall semester enrollments for full- and part-time students in the following categories: county residents entering MC immediately after high school graduation; county residents entering MC for the first time 1 to 3 years after high school graduation; returning MC students; first-time students between the ages of 20 and 55; residents of other Maryland counties; and non-residents of Maryland. The independent variables in the study were population source, the unemployment rate, the consumer price index for the Washington metropolitan area, the tuition difference between MC and the University of Maryland, and the total amount of financial aid awarded to MC students. Study findings included: (1) of the five independent variables, only the total amount of financial aid awarded appeared to be highly correlated with student enrollment in a significant majority of the 12 student groups; (2) unemployment rate, consumer price index, and tuition difference did not significantly account for student enrollment variability in any of the 12 groups; and (3) only the equations which predicted out-of-state enrollments were found to have predictive validity. (AYC)

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MONTGOMERY COLLEGE

Montgomery County, Maryland

A Report on the Possible Influence of Economic Conditions in the Washington Metropolitan Area on Student Enrollment at Montgomery College.

October 1983

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EXECUTIVE SUMMARY

Purpose:

It has been hypothesized by members of the Montgomery College Board of Trustees and the College administration that enrollment patterns at Montgomery College are influenced by general economic conditions in the Washington metropolitan area, particularly Montgomery County, and the cost of education to prospective students. The purpose of this study was to investigate the nature of possible relationships between student enrollment and these economic and cost variables, and where appropriate, to use such relationships to modify the current College enrollment projection model.

Methodology

The methodology used in this study is statistical in its approach and consists of a correlation analysis and a time series multiple regression model. It attempts to develop mathematical equations which can be used to predict enrollment for future fall semesters in twelve categories of students which together comprise the total on-campus student population of the College.

The independent variables in the study are population source, the unemployment rate and the consumer price index for the Washington metropolitan area (each lagged nine months), the tuition difference between the University of Maryland and Montgomery College, and the total amount of financial aid awarded to Montgomery College students.

Limitations

The major limitation in this study was the size of the data base used to estimate the regression coefficients in each of the twelve possible regression equations considered. Only enrollment data covering the period 1974-1981 were available in the format necessary for inclusion in the analysis; that is, separated into the twelve categories of students considered in the study. Enrollment data for fall 1982 were available only after the analysis was completed and were therefore, used as a test of the predictive accuracy of the equations and to update the final regression equations.

Also, while the analysis looked at economic variables, it was not an attempt to do an econometric analysis, i.e., the variables were not analyzed for their degree of economic impact.

Major Findings:

The following major findings have resulted from the analyses described in the report:

1. Of the five independent variables considered in the study, only the total amount of financial aid awarded to Montgomery College students appears to be highly correlated with student enrollment in a significant majority of the twelve subgroups considered.

2. None of the three remaining economic variables - unemployment rate, consumer price index, and tuition difference - accounted for a significant percentage of the variability of student enrollment in any of the twelve subgroups.

3. Of the nine statistically significant regression equations obtained from the analysis, only the equations which predict the part-time out-of-state residents and the full-time out-of-state residents can be expected to provide enrollment estimates which predict accurately a component of the College enrollment.

Conclusion:

The general conclusions resulting from the study are that general economic conditions in Montgomery County do not appear to greatly influence enrollment patterns at Montgomery College and consequently, that the population components forecasting model currently used by the College appears to be superior to an alternative model premised primarily on the use of economic variables. However, the equations regarding out-of-state students appear to be reasonably reliable and can be used to predict enrollment of this group of students. Also, the regression equations developed could be helpful to the College's administration in selecting the best projection series derived from the current model.

INTRODUCTION

To date, enrollment projections at the College have been determined primarily by considering demographic factors only. It has been hypothesized recently by members of the College administration and the Board of Trustees, that various factors in the economy of the Washington metropolitan area, particularly Montgomery County, may also contribute significantly to enrollment patterns at the College, and that ignoring such factors may in fact be affecting the accuracy of the College's projections.

The purpose of this report is to present the results of a study which examined the relationship between particular economic variables, e.g. unemployment rate, consumer price index, tuition, etc., and student enrollment at the College, and developed, where appropriate, mathematical equations which could be used to adjust the forecast produced by the current enrollment projection model for those economic variables which have an impact on the College's enrollment.

CURRENT COLLEGE FORECASTING MODEL

Currently, the Office of Institutional Research generates enrollment projections using two different techniques: mathematical curve fitting and a statistical analysis based on yields from population components. In recent years, the latter has proven to be the more accurate, as well as the more flexible, of the two approaches. A more detailed description of this second method is presented below.

Enrollment projections using yields from population components are generated by segmenting the Montgomery College student population into three main categories: residents of Montgomery County, residents of other Maryland counties, and non-residents of Maryland. The first category is further divided into recent high school graduates and early placement students from Montgomery County high schools, returning students from previous semesters, and older adult County residents (20-55 years of age) who are first time enrollees at the College. By using historical and projected data for the populations which are the sources for these same components, projections for each of the groups can be determined. The overall enrollment for a given year is then projected as the sum of the projections for each of the five above-mentioned student groups for that year.

Since 1980, three series of five-year projections have been generated each year using the population components technique. These series, identified as the base, middle, and high series projections, are each associated with a particular set of assumptions about population sources, future enrollment patterns, and current and projected financial and physical resources of the College. Upon review and consideration of the three series and the underlying assumptions for each by the College administration, a decision is made as to which series will be the most accurate predictor of future enrollment at Montgomery College. Most recently, the high series projection or a mixture of projection series have been used in planning the College's future.

It should be noted that all enrollment projections using the population components method are for the fall semester only. Projections for spring and summer semester enrollments are then determined using the relatively stable historical ratio that exists between fall, spring and summer enrollment.

LITERATURE REVIEW

Prior to specifying a particular methodology to be used in this study, an extensive review of past research in this area was conducted. The purpose of such a review was twofold: to guide the researcher in the determination of the most appropriate statistical model for such a study and to aid in the identification of those economic variables which are most likely to have a significant impact on enrollment in higher education institutions.

The statistical models used by earlier researchers in this area generally were of two types: a cross-sectional study and a time series regression model. The former requires a great deal of survey data and consequently is quite expensive and laborious to conduct. In addition, studies using the cross-sectional approach, tended to be more effective in determining a demand function for an individual student for higher education, whereas the regression model yields mathematical equations which could be used to forecast headcount enrollment or student credit hours at a particular institution. For these reasons, the decision was made to employ a time series regression model for the study at Montgomery College.

The economic variables which proved to be most influential on enrollment in these past studies were unemployment and the cost of education to the student. However, it should be noted that although the effect of these variables on enrollment was statistically significant, the magnitude of the effect was in general small, and in fact decreased, when applied to students with relatively high family income attending two-year public institutions, a description which applies to a large percentage of Montgomery College students.

METHODOLOGY

The model employed in this study is a time series multiple regression model using enrollment measured by fall semester student headcount as the dependent variable. A time series multiple regression model takes the general form:

$$Y_t = a + b_1 X_{1t} + b_2 X_{2t} + \ldots + b_n X_{nt} + e_t,$$

where the dependent variable Y is described as a linear combination of the independent variables $X_1, X_2, \ldots, X_n$ plus an error term e representing all factors other than the independent variables which influence the dependent variable, and where the intercept a and regression coefficients $b_1, b_2 \ldots, b_n$ are estimated from a set of data points $(X_{1t}, X_{2t}, \ldots, X_{nt}, Y_t)$ $t = 1, \ldots, T$ with the time interval between two consecutive data points being fixed and constant. A "good" explanatory equation is one where the estimated coefficients, together with the known values of the independent variables, account for a much larger percent of the variation in the Y values than does the error term.

Based on the results of the literature review and the considered opinion of those involved with the project, the following five independent variables were originally hypothesized to have a statistically significant effect on enrollment: a demographic type variable which is population source and the following four economic related variables:

(i) the unemployment rate for the Washington metropolitan area lagged nine months; that is, an increase in the unemployment rate was hypothesized to coincide with an increase enrollment nine months later. In particular, the January unemployment rate is used in predicting fall enrollments.

(ii) the consumer price index for the Washington metropolitan area lagged nine months[1].

(iii) the tuition difference by residence classification between competing area universities and Montgomery College. In

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[1]For the years 1974-1977, the index for February was used. Beginning in 1978, the Bureau of Labor Statistics changed their reporting schedule to include January.

performing the statistical analyses, three possible measures of this tuition difference were considered: the difference in tuition between the University of Maryland and Montgomery College, the difference in tuition between George Washington University and Montgomery College, and the difference of the averaged tuition of the University of Maryland and George Washington University with Montgomery College. The University of Maryland was considered since it is the most likely alternative choice for most Montgomery College students seeking a public institution. George Washington University was considered since its tuition levels are representative of most competing area private institutions.

In obtaining the results contained in this report the tuition difference between the University of Maryland and Montgomery College was used since it was believed that very sizeable recent and proposed future increases in tuition at George Washington (and at other private institutions) would likely distort the significance of this variable on enrollment at Montgomery College. In point of fact, statistical analyses were performed using all three tuition difference measures, with the best predictive results being obtained with the tuition difference between Maryland and Montgomery College.

(iv) the total dollar amount (in thousands of dollars) of financial aid awarded to Montgomery College students in any given year. This includes all scholarships, grants, and government loan programs.

It is a reasonable supposition that the four economic variables might have significantly varying effects on different segments of the College student population. Therefore, individual regression equations have been determined for each of the following subgroups which together comprise the total on-campus student population of Montgomery College:

1. Montgomery County residents who are early placement students or high school graduates entering immediately after graduation.

2. Montgomery County residents entering Montgomery College one to three years after their high school graduation.
3. Montgomery County residents who are returning students from previous semesters.
4. Montgomery County residents between the ages of 20 and 55 enrolling at Montgomery College for the first time.
5. Residents of other Maryland Counties.
6. Non-residents of Maryland.

These groups represent the same ones that are currently being used by the Montgomery College Office of Institutional Research to forecast enrollment with the population components method discussed in section II of this report, with the exception of the "recent Montgomery County high school graduates" component which for the purposes of this study, has been split into the subgroups 1 and 2 described above.

Economic conditions, as well as financial considerations, may also play a major role in whether a student enrolls as a full-time or part-time student. Consequently, each of the above six subgroups is analyzed separately according to full-time or part-time enrollment status. Therefore in total, regression equations are hypothesized for 12 separate subgroups of students at the College.

The regression coefficients in each of the 12 equations are initially estimated using fall semester enrollment data covering the eight year span, 1974-1981. Enrollment data from years prior to 1974, although available, were collected in a format which did not allow for a breakdown consistent with the twelve subgroups used in this study.

Using these data, the statistical analysis is as follows:

1. Correlation coefficients and partial correlation coefficients between student headcount and each of the five independent variables are calculated for all twelve subgroups of students.

2. For each subgroup, student headcount is regressed on the subset of independent variables whose partial correlations are in the

hypothesized direction with student headcount using a stepwise multiple regression procedure. In the case of four of the independent variables, namely population source, unemployment rate, tuition difference, and financial aid, if a meaningful partial correlation with headcount exists, it should be in the positive direction; that is, an increase in any one of these variables should be associated with an increase in enrollment for that year. On the other hand, the consumer price index would be expected to be negatively correlated with enrollment.

3. For these same subgroups where statistically significant equations are determined, the accuracy of these equations is tested by comparing the predicted headcount for that subgroup for the fall, 1982 semester with the number of students in that category that actually enrolled at the College in fall 1982.

4. For these same subgroups the regression equations are updated by including the fall 1982 data as a ninth observation in estimating the regression coefficients.

5. Using these updated regression equations, headcount predictions are made for the fall, 1983 semester.

RESULTS

Tables I and II show simple and partial correlation coefficients for student enrollment in the 12 subgroups with each of the five independent variables. The Pearson's correlation (r) coefficient measures the association of enrollment with a particular variable, while the partial correlation measures this association under the assumption that the effects of the other independent variables on enrollment variability have been removed.

TABLE I
SIMPLE CORRELATIONS BETWEEN INDEPENDENT VARIABLES
AND STUDENT ENROLLMENT - FALL SEMESTER*

SUBGROUP	POPULATION SOURCE	UNEMPLOY-MENT RATE	CONSUMER PRICE INDEX	TUITION DIFFERENCE	FINANCIAL AID
H.S. Immediate-Part	-.673	.305	.241	.290	.835
H.S. Immediate-Full	.378	-.310	-.165	.555	-.370
H.S. Delayed-Part	-.323	-.082	.507	.651	.861
H.S. Delayed-Full	.495	.168	-.623	.142	-.364
Older Adults-Part	-.729	.243	.281	.463	.873
Older Adults-Full	-.650	.528	-.007	.111	.720
Returning Students-Part	.949	.187	.418	.502	.940
Returning Students-Full	-.156	-.588	.226	.190	-.335
Out-of-County Residents-Part	.113	-.166	.666	.277	.957
Out-of-County Residents-Full	-.116	-.193	.677	.294	.939
Out-of-State Residents-Part	-.083	-.378	.734	.490	.857
Out-of-State Residents-Full	.680	.164	.270	.675	.570

* The fact that many signs are not in the expected direction implies that multi-colinearity might exist among the variables in the equations.

TABLE II

PARTIAL CORRELATION BETWEEN STUDENT ENROLLMENT
AND INDEPENDENT VARIABLES

SUBGROUP	VARIABLE				
	POPULATION SOURCE	UNEMPLOYMENT RATE	CONSUMER PRICE INDEX	TUITION DIFFERENCE	FINANCIAL AID
H.S. Immediate-Part[1]	*	-.1669	-.4164	-.3476	.7423
H.S. Immediate-Full	-.4944	-.7764	-.270	-.7692	-.3597
H.S. Delayed-Part	-.2363	.4671	.3873	.7142	.2317
H.S. Delayed-Full	.5027	-.6840	-.5684	.6475	.0888
Older Adults-Part	-.9102	.7096	.5117	.5294	.5611
Older Adults-Full	-.6184	.5441	-.3099	-.6041	.8103
Returning Students-Part[1]	.1825	.2682	*	.3795	.5753
Returning Students-Full	.2518	-.3039	.2970	.3777	-.5597
Out-of-County Residents-Part	.8109	-.4687	.0422	.2378	.9508
Out-of-County Residents-Full	-.0881	-.3213	-.1509	.2274	.8790
Out-of-State Residents-Part	.5907	-.7506	-.4295	-.3158	.8980
Out-of-State Residents-Full	.9116	-.4448	-.3059	.1283	.7970

(1) Due to the near singularity of the partial correlation matrix when all 5 variables were included, the partial correlations were recalculated using the 4 variables indicated. The variable to be eliminated in these two cases was determined from the direction of the correlations in Table I.

Realistically all partial correlations, with the exception of those for the consumer price index, should be positively signed; that is an increase in that particular independent variable should be associated with an increase in student enrollment. The consumer price index should have the reverse effect. As can be seen in summary tables IIIA and IIIB, this was not the case to the degree one would have expected. Possible explanations for this situation will be discussed in a later section.

TABLE IIIA
VARIABLES WITH PARTIAL CORRELATION
IN ASSUMED DIRECTION

SUBGROUP	VARIABLES*
H.S. Immediate-Part	CPI, FA
H.S. Immediate-Full	CPI
H.S. Delayed-Part	U, T, FA
H.S. Delayed-Full	P, T, FA, CPI
Older Adults-Part	U, T, FA
Older Adults-Full	U, FA, CPI
Returning Students-Part	P, U, T, FA,
Returning Students-Full	P, T
Out-of-County Residents-Part	P, T, FA
Out-of-County Residents-Full	T, FA, CPI
Out-of-State Residents-Part	P, FA, CPI
Out-of-State Residents-Full	P, T, FA, CPI

*P - Population Source
U - Unemployment Rate
T - Tuition Difference
FA - Financial Aid
CPI - Consumer Price Index

TABLE IIIB
NUMBER OF SUBGROUPS WITH
CORRELATIONS IN ASSUMED DIRECTION

VARIABLE	NUMBER OF SUBGROUPS TO BE INCLUDED IN
Population Source	6
Unemployment Rate	4
Consumer Price Index	7
Tuition Difference	8
Financial Aid	10

Using the variables indicated in Table IIIA, equations were constructed for each subgroup using a stepwise multiple regression procedure. The particular procedure used[2] selects at each step, an independent variable for possible inclusion in the equation based on which of the variables explains the largest percentage of the total variation in student enrollment among the remaining variables.

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[2]The stepwise regression procedure used was from the STATPAK statistical package on the MUSIC (McGill University System for Interactive Computing) system.

Continuation of the procedure at any step was based on whether the selected variable accounted for at least 3% of the total variation and had a p-value no larger than .2. Resulting equations were considered significant if the p-value of the equation was no greater than .1 ($p \leq .1$). The results of this analysis are given in TABLE IV.

TABLE IV
RESULTS OF STEPWISE REGRESSION

SUBGROUP	= REGRESSION EQUATION[1]	R[3]	$R^2 \times 100$[4]	p-VALUE[5]	STANDARD ERROR OF ESTIMATE[6]
H.S. Immed.(P)[2]	= 516.8+.0397(FA) - 14(C)	.89	79.9	.018	39.1
H.S. Immed.(F)[2]	= No Significance	-	-	-	-
H.S. Delayed(P)	= 247+.009(FA)+1.76(T)	.92	84.9	.009	11.7
H.S. Delayed(F)	= No Significance	-	-	-	-
Older Adults(P)	= -148.7+.305(FA)+309.9(U)	.91	82.2	.013	346.7
Older Adults(F)	= 505.3+.0668(FA)-38.3(C)	.90	81.4	.015	60.5
Returning (P)	= 2312.6+.263(POP)+.175(FA)	.97	93.9	.001	224.6
Returning (F)	= No Significance	-	-	-	-
Out-of-County(P)	= 138.6+.0448(FA)	.96	91.6	.000	29.1
Out-of-County(F)	= 95.8+.026(FA)+.15(T)	.96	91.4	.002	17.2
Out-of-State(P)	= 190.6+.021(FA)+10.7(C)	.90	81.1	.016	33.1
Out-of-State(F)	= -1755.9+.4489(POP)+ .0432(FA)	.94	88.7	.004	52.2

Independent Variables are:
POP - Population Source
U - Unemployment Rate
T - Tuition Difference
FA - Financial Aid
C - Consumer Price Index

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[1]The order of variables in the equation is the same as the order of selection of variables in the stepwise regression procedure.

[2]P = Part-time enrollment
F = Full-time enrollment

[3]R : Multiple Correlation Coefficient - a measure of the linear relationship between student headcount and a set of independent variables.

[4]R^2 : Coefficient of determination - the proportion of variance in student headcount explained by the regression equation; i.e., the goodness of fit of the regression equation.

[5]p value : The probability that the observed linear relationship between student headcount and the independent variables is due to chance occurence.

[6]Standard Error of Estimate : standard deviation of the difference between actual student headcount value and predicted student headcount values.

In all subgroups except high school students enrolling as full-time students immediately after graduation, high school students enrolling as full-time students one to three years after graduation, and students returning on a full-time basis, statistically significant regression equations satisfying the above constraints were determined. However, of the five independent variables under consideration, financial aid was the only one which exhibited significance across a broad segment of the student population at Montgomery College, appearing as the primary variable in seven of the nine equations and as a secondary variable in the other two. The remaining four variables turned out to be explanatory variables only in very selected instances; consumer price index in three groups, tuition difference and population source in two groups, and unemployment rate in only one group - older adults enrolling as part-time students.

The predictive accuracy of the equations in Table IV was tested by using them to forecast fall, 1982 enrollment for the respective subgroups. The values obtained were then compared to the actual enrollments for these groups for fall, 1982. In only five of the nine subgroups was the predicted enrollment within ten percent of the actual enrollment. This large discrepancy between predicted and actual enrollments indicates that in general, the equations cannot be used as good predictors with a high degree of confidence. Probably the most encouraging result of this analysis was the fact that for the two groups of students representing out-of-state residents, the regression equations generated predictions to within 2.4 percent of the actual value in both cases. Since this component of enrollment has been the most difficult to forecast with the population components approach currently used by the College, the regression equations should provide useful information in predicting enrollment levels for that subgroup. The complete results of these comparisons for the nine subgroups are shown in Table V.

TABLE V
ENROLLMENT PREDICTIONS FOR FALL 1982 FROM EQUATIONS

SUBGROUP	PREDICTED FALL 82	ACTUAL FALL 82	RESIDUAL (ACTUAL-PREDICTED)	% ERROR (RESIDUAL/ACTUAL*100)
H.S. Immed.-P	638	579	- 59	-10.2%
H.S. Delayed-P	348	295	- 53	-18.0%
Older Adults-P	3485	3264	-221	- 6.8%
Older Adults-F	590	468	-122	-26.1%
Returning -P	6831	5984	-847	-14.2%
Out-of-County -P	405	440	35	+ 8.0%
Out-of-County -F	207	224	17	+ 7.6%
Out-of-State - P	402	412	+10	+ 2.4%
Out-of-State - F	564	551	-13	- 2.4%

In each of the nine subgroups the regression coefficients were reestimated by including the fall, 1982 semester as a data point. The resulting equations, now estimated using data spanning the nine years 1974-1982 are shown in Table VI. Changes in the equations for three of the subgroups which are worth noting are: in the high school delayed part-time subgroup umemployment rate replaced tuition difference as the second explanatory variable and in the returning part-time and out-of-county full-time subgroups, a second explanatory variable was no longer included. One consequence of these adjustments is that tuition difference does not appear as a significant explanatory variable for enrollment in any of the 12 subgroups.

TABLE VI

FINAL REGRESSION EQUATIONS ESTIMATED
USING 1974-82 ENROLLMENT DATA*

SUBGROUP	REGRESSION EQUATION	R[1]	R^2X100[2]	p-VALUE[3]	STANDARD ERROR OF ESTIMATE[4]
H.S. Immediate(P)	= 492.3+.0335(FA)-9.6(C)	.877	76.9	.012	40.1
H.S. Immediate(F)	= No Significance				
H.S. Delayed(P)	= 337.5+.0091(FA)-13.3(U)	.781	61.0	.059	17.3
H.S. Delayed(F)	= No Significance				
Older Adults(P)	= 147.0+.2937(FA)+251.9(U)	.924	85.3	.003	322.6
Older Adults(F)	= 454.7+.054(FA)-29.2(C)	.865	74.8	.016	66.9
Returning(P)	= 937.6+.5395(POP)	.949	90.2	.000	336.7
Returning(F)	= No Significance				
Out of County(P)	= 133.7+.0474(FA)	.964	92.9	.000	29.3
Out of County(F)	= 62.9+.0248(FA)	.950	90.2	.000	18.2
Out of State(P)	= 194.6+.0221(FA)+10(C)	.910	82.8	.005	30.6
Out of State(F)	= -1803.5+.4583(POP)+.0427(FA)	.949	90.0	.001	47.8

Independent Variables are:

POP=Population Source
U =Unemployment Rate
C =Consumer Price Index
T =Tuition Difference
FA =Financial Aid

*Order of variables in the equation is order of selection in stepwise regression procedure.

[1]R : Multiple Correlation Coefficient - a measure of the linear relationship between student headcount and a set of independent variables.

[2]R^2 : Coefficient of determination - the proportion of variance in student headcount explained by the regression equation; i.e., the goodness of fit of the regression equation.

[3]p value : The probability that the observed linear relationship between student headcount and the independent variables is due to chance occurence.

[4]Standard Error of Estimate : standard deviation of the difference between acutal student headcount value and predicted student headcount values.

DISCUSSION

The results of the foregoing analysis do not lend strong support to the hypothesis that tuition, unemployment rate, and the consumer price index are significant contributing factors to enrollment patterns at the College. In fact, as previously noted, the latter two variables appear as significant variables for only two of the groups, while tuition difference plays no major role for any of the groups. Of the four economic variables considered then, only financial aid appears to explain a significant percentage of the variability in student enrollment for the different subgroups.

A reasonable explanation for the non-significance of tuition difference as an explanatory variable for enrollment, is that the more important financial factor in a student's decision to attend college is the net cost of the education to that student. The dramatic increase in total financial aid awarded to Montgomery College students, particularly over the period 1977-1980 when the figure more than tripled from 1.9 million dollars to over 6 million dollars, more than overshadowed changes in the tuition difference between the University of Maryland and Montgomery College over that same period. As a matter of fact, while the tuition difference between these two schools for a Montgomery County resident enrolling as a full time student remained relatively stable at approximately $70 from 1974 to 1980, the amount of financial aid per student attending Montgomery College during that same period increased from $94 to $359. (See Appendix A). The fact that student financial aid strongly correlates with student enrollment may imply that tuition pricing is important to many college students. Student financial aid reduces prices and thus student enrollment appears to be sensitive to price.

The relative non-significance of unemployment as an explanatory variable is also not surprising given the generally recession-proof economy of the Washington metropolitan area and Montgomery County in particular. In fact, during the years 1975 - 1981, the unemployment rate fluctuated between the rather narrow range of 4.5 percent to 5.6 percent.

An alternative and somewhat more intriguing explanation that can be advanced for the relative non-significance of tuition, consumer price index, and unemployment as explanatory variables for enrollment at the College, is the existence of a complex, three way interaction between these variables and student enrollment; that is, that only when certain levels of one or more of

these variables are achieved coincidentally, does their influence on enrollment become clearly evident. Unfortunately, such considerations were beyond the scope of this study.

In addition, this study did not attempt to analyze enrollment patterns at the College according to the socio-economic status of County residents; that is, the possible effects of tuition increases or fluctuations in the unemployment or inflation rates on student enrollment from low-income groups in the County, for example.

With regard to the correlations given in Tables I and II, it seems that when more data points are added to the analysis, single correlation coefficients between student enrollment and independent variables will be improved, particularly with aggregate data. For instance, when one more data point is added to the analysis, the simple correlation coefficient between population source and the aggregate "High-school Immediate" group increases from -.032 to .0481.

The regression equations given in Table VI were used to generate predictions of student enrollment for nine subgroups for the Fall, 1983 semester[3]. These are shown in Table VII. It must be emphasized that these predicted values, as before, must be interpreted with a great deal of caution since the regression coefficients were estimated using an extremely small (nine) number of data points. This fact is reflected in the rather wide 90 percent confidence bands for the predicted values contained in Table VII. They suggest that values of the multiple correlation coefficient (R) and the significance level (p-value) for the equation given in Table VI may overestimate the predictive accuracy of the equations. This discrepancy can be the consequence of serial correlation in the model, i.e, correlation between successive error terms, e_t and e_{t+1}, in the regression equation. The existence of such correlation would violate a major theoretical assumption of the regression model - that all errors terms be completely uncorrelated.

Unfortunately, although statistical tests exist to test for serial correlation, e.g., the Durbin-Watson statistic, their effectiveness in detecting such correlation decreases dramatically when the number of data points is very small.

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[3]The total financial aid to be awarded during the 1983-84 academic year was estimated using figures provided by the College's Office of Financial Aids.

TABLE VII

FALL 1983 ENROLLMENT PREDICTIONS

SUBGROUP	PREDICTED FALL'83 ENROLLMENT	90% CONFIDENCE INTERVAL
H.S. Immediate(Part)	658	[592, 724]
H.S. Delayed(Part)	316	[288, 344]
Older Adults(Part)	3396	[2867, 3925]
Older Adults(Full)	668	[558, 778]
Returning(Part)	6855	[6303, 7407]
Out of County(Part)	422	[374, 470]
Out of County(Full)	214	[184, 244]
Out of State(Part)	369	[319, 419]
Out of State(Full)	473	[395, 551]

In using the predicted values to adjust forecasts from the population components model an additional fact must be considered. In order to break down the 1974-1982 enrollment data into the twelve subgroups needed for this study, a version of the SPSS cross files subroutine was used. This program discards any data points with incomplete information, that is, any enrollees with a missing residence code or classification.

These enrollees, however, are included in the data base used by the Office of Institutional Research and consequently, forecasts produced by the population components method will be slightly higher than those of the regression model. The data bases for both models comes from third week enrollment figures.

It should also be noted that the effectiveness of any of the regression equations which include financial aid as an independent variable will be influenced somewhat by the ability of the user to project the dollar amount for that variable for the year in question. Such projections are available and updated regularly by the Office of Financial Aids.

CONCLUSION

As noted at the beginning of this report, the purpose of this study was basically twofold: to investigate the nature of a possible relationship between economic conditions in the County and enrollment at Montgomery College and where appropriate to use this relationship to modify the College's current enrollment projection model. Given the problems discussed previously, the regression equations developed cannot in general be used with a high degree of confidence to provide point estimates for student enrollment in the majority of the 12 subgroups. In this respect then, the current population components model should be considered as superior to the one produced by this study. The one possible exception to this would be for the out-of-state residents component of the current model, where the population yields approach for that group has not been as accurate a predictor as is desired. In this case, a combined projection for that component based on the two regression equations given in Table VI, could be used in lieu of the current model.

It should also be noted that the effectiveness of any of the regression equations which include financial aid as an independent variable will be influenced somewhat by the ability of the user to project the dollar amount for that variable for the year in question. Such projections are available and updated regularly by the College Office of Financial Aids.

The second most useful application of the results of this study would appear to be as an additional source of information and a guideline to help the College administration to determine which of the three projection series generated, the base, middle, or high series, will best predict future enrollment patterns at the College. In particular, the confidence intervals given in Table VII, although wider than one might like to see, should prove useful for this purpose. In this regard, assuming that the regression coefficients for all the groups are reestimated each year using an additional data point, the standard estimates of the error should decrease, narrowing the confidence intervals to more satisfying widths in future years.

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APPENDIX A
DATA VALUES FOR ECONOMIC VARIABLES

YEAR	CPI[1]	EMPLOYMENT RATE[1]	TUITION DIFFERENCE IN COUNTY		OUT OF COUNTY		OUT OF STATE		FINANCIAL AID[2] ($000's)
			P	F	P	F	P	F	
1974	10.2	3.8	14	72	- 9	-101	-26	249	1024.6
1975	9.7	4.5	13.5	72	- 9	-251	-31	229	1645.6
1976	5.8	5.6	14	75	-11	-281	-36	224	1889.1
1977	6.5	4.7	24	70	- 1	-268	-26	237	1977.2
1978	7.2	5.3	14	64	-13	-281	-31	389	2203.7
1979	10.0	5.0	13	61	- 9	-254	-27	481	4128.0
1980	11.1	4.5	16	67	-11	-338	-31	336	5939.5
1981	10.9	4.6	26	162	- 1	-243	-21	491	6053.9
1982	8.1	5.9	27	153	- 2	-282	-24	452	5917.9
1983	4.0	5.8	*	*	*	*	*	*	6017.8

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(1)Source: U. S. Bureau of Labor Statistics
(2)Source: HEGIS Reports

*Not called for in the equation for prediction.
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